

Appl. No. 10/699,839
Amendment dated: September 19, 2005
Reply to OA of: June 20, 2005

REMARKS

Applicants have amended the specification to correct the typographical and grammatical errors set forth in Official Action.

Applicants have amended the claims to overcome the objections to the claims set forth in the outstanding Official Action. Along with amendments made for clarification purposes, the term "epitaixial" has been replaced in all of the claims with the term "epitaxial." Also, new independent claim 19 has been added to further define an embodiment of the present invention. Support for this claim can be found throughout the specification and the claims. Applicants most respectfully submit that all claims now present in the application are in full compliance with 35 U.S.C. §112 and are clearly patentable over the references of record.

The rejection of claims 1-13 under 35 U.S.C. §103(a) as being unpatentable over Lochtefeld in view of Chen and other remarks has been carefully considered but is most respectfully traversed.

Applicants wish to direct the Examiner's attention to the basic requirements of a prima facie case of obviousness as set forth in the MPEP § 2143. This section states that to establish a prima facie case of obviousness, three basic criteria first must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine the reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations.

The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure. In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

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Section 2143.03 states that all claim limitations must be taught or suggested by the prior art. In re Royka, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). "All words in a claim must be considered in judging the patentability of that claim against the prior art." In re Wilson, 424 F.2d 1382, 1385, 165 USPQ 494, 496 (CCPA 1970). If an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. In re Fine, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988).

The Official Action urges that Lochtefeld discloses a process for growing a GaAs epitaxial layer on Ge/SiGe/Si substrate comprising a first step of providing a clean silicon wafer 12. However, Applicants note that there is no teaching or suggestion in the reference that the silicon wafer 12 is cleaned. Therefore Lochtefeld fails to disclose this element of the present invention.

The Official Action next urges that Lochtefeld discloses a second step of growing a first SiGe epitaxial layer 14 with a certain thickness wherein the layer comprises at least 70wt.% of Ge (page 4, [0062]), growing a second layer 16 wherein the Ge content (page 4, [0063]) is more than that of the first one and performing in-situ high temperature annealing of the second (and optional third) layer during the growing period (page 2, [0024]). The Official Action urges that the first SiGe layer 14 comprises a maximum Ge content of 10-80% that can be set to 70% and the second layer has a Ge content of 10-80% that can be set to 80%. Applicants respectfully traverse these statements.

First, Lochtefeld fails to disclose in-situ high temperature annealing of the two layers during the growing periods as claimed in the present invention. While the Official Action cites paragraph [0024] as teaching this step, a careful reading of paragraph [0024] reveals that it is in reference to strained semiconductor layer 18, which is disposed on second layer 16. Thus, even if paragraph [0024] discloses in-situ high temperature annealing, which Applicants do not believe it does, the annealing would be with respect to strained semiconductor layer 18, not the second layer 16. Thus,

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Lochtefeld fails to disclose or suggest this element of the presently amended claims and cannot properly support a §103 rejection.

As alluded to above, Applicants also assert that paragraph [0024] does not disclose in-situ high temperature annealing as claimed in the present invention. The annealing process mentioned in Lochtefeld is just for testing the strained semiconductor layer 18 and cannot be considered as a step of whole growth process. This is supported by the fact that no annealing process is mentioned in the detailed description of the drawings, wherein the step-by-step process of preparing the strained-semiconductor-on-insulator device structure of the Lochtefeld invention is explained. The cursory reference to the annealing step does not meet the limitation of the presently amended claims and therefore Lochtefeld cannot properly support a §103(a) rejection.

Also, while the Official Action indicates that the second layer 16 could be set to 80% Ge content and the first layer 14 could be set to 70% Ge content, thus meeting the limitations of claim 1, there is no support in the reference for why one skilled in the art would find it obvious to choose these two specific parameters. As indicated above, the motivation to modify references must come from the prior art, not the Applicants' specification. There is no teaching or suggestion in the reference as to why the second layer should have a higher Ge content than the first layer, and therefore one skilled in the art would not be motivated by Lochtefeld to make such a modification to the invention of Lochtefeld. The present invention has discovered that by growing layers with increasing Ge contents, the lattice mismatches, which lead to the formation of a network of misfit dislocations at the interface and high density threading dislocations in the epitaxial layer, are reduced. Lochtefeld makes no such disclosure about the benefit of increasing the Ge content of the layers, and thus fails to provide the proper motivation for such a modification.

The Official Action next urges that Lochtefeld discloses growing a pure Ge film 18 on the epitaxial layer from step (4) of the claimed invention and growing GaAs

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epitaxy on the Ge film (page 4, [0065]). Applicants most respectfully traverse this statement.

The Official Action also urges that strained semiconductor layer 18 of Lochtefeld meets the claim limitation of growing a pure Ge film on the epitaxial layer from step (4). The Official Action continues that paragraph [0065] discloses growing a GaAs epitaxy layer on the Ge film. However, a careful reading of paragraph [0065] reveals that paragraph [0065] is with reference to strained semiconductor layer 18 and does not disclose the additional step of growing a GaAs layer on strained semiconductor layer 18 as urged by the Official Action. Therefore, the Official Action has given no indication of where in Lochtefeld is disclosed a GaAs epitaxy disposed on the Ge film. Inspection of figure 1A supports this, as it can clearly be seen that layer 18 is the top layer of the structure and no other layer (e.g., a GaAs epitaxy as claimed in the present invention) is deposited on top of layer 18. Applicants therefore respectfully request that the §103(a) rejection be withdrawn for failing to disclose or suggest each and every element of the presently claimed invention.

Applicants would also like to point out that layer 14 of Lochtefeld is not the same as Applicants first SiGe epitaxial layer as claimed in claim 1. Lochtefeld discloses a first SiGe layer that is a typical Ge graded layer, and this layer must be thick (e.g., 1-8 μ m). This graded layer causes the typical cross-hatch pattern on the surface of the SiGe layer and a chemical-mechanical polishing step must be employed to flatten the surface. To the contrary, the present invention discloses a first SiGe layer that is a simple, uniform layer directly grown on the Si substrate with a high Ge composition. The present invention purposefully uses a layer with a thickness less than 0.8 μ m that exhibits no rough surface or cross hatch pattern. Accordingly, Lochtefeld fails to disclose this element of the present invention and cannot properly support a §103(a) rejection.

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With reference to claim 2, the Official Action urges that paragraph [0066] discloses the claimed temperatures and pressures under which all of the layers are deposited. However, careful inspection of paragraph [0066] reveals that paragraph [0066] is with reference to layer 18 only, and further makes no mention of pressure ranges at all. Therefore, Lochtefeld clearly fails to meet the specific temperature and pressure elements claimed in claim 2 of the present invention. Accordingly, Applicants respectfully request that this rejection be withdrawn.

Claims 3-13 all depend from claim 1, which Applicant has shown is clearly not disclosed by the Lochtefeld reference. Accordingly, Applicants respectfully request that the §103(a) rejection of these claims also be withdrawn.

With respect to the Chen reference, the Official Action urges that Chen discloses in-situ high temperature annealing of a first layer and that combining the teachings of Chen with the invention of Lochtefeld would be obvious in order to achieve the required total Si/SiGe thickness without the critical thickness of the strained layer (col. 3, lines 43-45). Applicants specifically traverse this statement. Chen generically states at col. 3, lines 39-45 that "deficiencies of the prior art methods for forming a strained Si/SiGe-on insulator structure are alleviated through use of the method of the present invention, in which a SiGe buffer is added in between the stained layer and the insulator to achieve the required total Si/SiGe thickness without exceeding the critical thickness of the strained layer." Applicants note that the beneficial aspect of the invention disclosed in Chen is attributed to the addition of a SiGe buffer between the stained layer and the insulator, and makes no mention of the annealing step. In fact, Chen discloses at col. 4, lines 50-57, that the annealing step may not even be necessary to the invention of Chen. Therefore, Applicants assert that the motivational statement provided for combining the teachings of Chen with the invention of Lochtefeld is improper because the annealing step does not contribute to the beneficial aspect of the Chen reference identified in the motivation statement. Accordingly, Applicants respectfully request that


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the rejection of claims 1-13 under §103(a) over Lochtefeld in view of Chen be withdrawn.

In view of the above comments and further amendments to the claims, favorable reconsideration and allowance of all of the claims now present in the application are most respectfully requested.

Respectfully submitted,

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